

## EXHIBIT 1

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(54) 【発明の名称】 封止用エポキシ樹脂組成物及びそれを用いた半導体装置

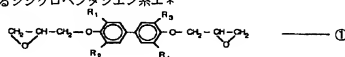
(57) 【要約】

【目的】 耐湿性、耐吸湿半田クラック性、密着性に優れ、ポストキュア後の変色を低減した緑色の封止用エポキシ樹脂組成物及びそれを用いた半導体装置を提供する。

【構成】 1分子中に2個以上のエポキシ基を有するエポキシ樹脂に、硬化剤として1分子中に2個以上のフェノール性水酸基を有するフェノール樹脂、無機充填剤、硬化促進剤及び顔料を添加してなる封止用エポキシ樹脂組成物において、前記エポキシ樹脂として、ビスフェニル型エポキシ樹脂及び／又はジシクロペンタジエン系エポキシ樹脂を含有し、かつ、前記顔料として、塩素化銅フタロシアニングリーンを封止用エポキシ樹脂組成物全量に対して0.05～1重量%及びカーボンブラックを封止用エポキシ樹脂組成物全量に対して0.01～0.2重量%含有する。前記封止用エポキシ樹脂組成物の硬化物により封止してなる。

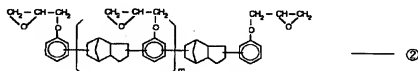
## 【特許請求の範囲】

【請求項1】 1分子中に2個以上のエポキシ基を有するエポキシ樹脂に、硬化剤として1分子中に2個以上のフェノール性水酸基を有するフェノール樹脂、無機充填剤、硬化促進剤及び顔料を添加してなる封止用エポキシ樹脂組成物において、前記エポキシ樹脂として、下記の一般式①で表されるビスフェニル型エポキシ樹脂及び/又は下記の一般式②で表されるジシクロペンタジエン系エ



(式中R<sub>1</sub>、R<sub>2</sub>は、H、CH<sub>3</sub>又はC<sub>2</sub>H<sub>5</sub>である。)

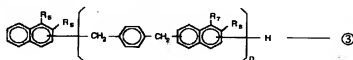
## 【化2】



(式中mは繰り返し単位を示す0～5の数)

【請求項2】 前記フェノール樹脂として、下記の一般式③で表されるフェノール樹脂を含有することを特徴とする請求項1記載の封止用エポキシ樹脂組成物。 ※する請求項1記載の封止用エポキシ樹脂組成物。

【化3】



(式中R<sub>1</sub>、R<sub>2</sub>は、H、フェノール性水酸基、ハロゲン原子又は炭素数1～5のアルキル基で、nは繰り返し単位を示す1～5の数である。)

【請求項3】 請求項1又は請求項2記載の封止用エポキシ樹脂組成物の硬化物により封止してなることを特徴とする半導体装置。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】本発明は、電気部品、電子部品、半導体素子等を封止するための封止用エポキシ樹脂組成物及びそれを用いた半導体装置に関する。

## 【0002】

【従来の技術】従来、ダイオード、トランジスタ、集積回路等の電気・電子部品や半導体装置等の封止方法として、例えば、エポキシ樹脂やシリコン樹脂等による樹脂封止方法や、ガラス、金属、セラミックス等を用いたハーメチックシール法が採用されてきているが、近年では、信頼性の向上とともに大量生産やコストの面でメリットのあるエポキシ樹脂を用いる封止法においては、クレゾールノボラック型樹脂を樹脂成分とし、かつ、フェ

\* ポキシ樹脂を含有し、かつ、前記顔料として、塩素化銅フタロシアニングリーンを封止用エポキシ樹脂組成物全量に対して0.05～1重量%及びカーボンブラックを封止用エポキシ樹脂組成物全量に対して0.01～0.2重量%含有することを特徴とする封止用エポキシ樹脂組成物。

## 【化1】

ノールノボラック型樹脂を硬化剤成分とする組成物からなる成形材料が最も一般的に使用されている。

【0003】しかしながら、IC、LSI、VLSI等の電子部品や半導体装置の高密度化、高集積化にともなう、モールド樹脂の薄肉化が進んでおり、これまでのエポキシ樹脂組成物では、必ずしも満足に対応することができなくなっている。例えば、表面実装用デバイスにおいては、実装時にデバイス自身が半田に直接浸漬される等、急激に高温苛酷環境下に曝されるため、パッケージクラックの発生が避けられない事情となっている。すなわち、成形後の保管中に吸湿した水分が、高温にさらされる際に急激に気化膨張し封止樹脂がこれに耐えきれずに半導体装置のパッケージにクラックが生じる。また、一部のダイオードやトランジスタには、緑色を使用されているものもあるが、封止用エポキシ樹脂組成物は、一般的に黒色である。緑色は、イメージが良く、目立つので、封止用エポキシ樹脂組成物として使用したい

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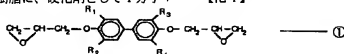
が、通常の緑色の顔料を用いると、耐湿性が悪く、ポストキュア後に変色するというような問題点があった。

【0004】

【発明が解決しようとする課題】本発明は前記の事情に鑑みてなされたもので、その目的とするところは、耐湿性、耐吸湿半田クラック性、密着性に優れ、ポストキュア後の変色を低減した緑色の封止用エポキシ樹脂組成物及びそれを用いた半導体装置を提供することにある。

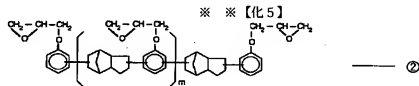
【0005】

【課題を解決するための手段】本発明の請求項1に係る封止用エポキシ樹脂組成物は、1分子中に2個以上のエポキシ基を有するエポキシ樹脂に、硬化剤として1分子\*



(式中R<sub>1</sub>、R<sub>2</sub>は、H、CH<sub>3</sub>又はC<sub>2</sub>H<sub>5</sub>である。)

【0007】



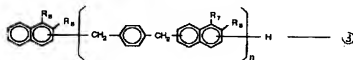
(式中mは繰り返し単位を示す0～5の数)

【0008】本発明の請求項2に係る封止用エポキシ樹脂組成物は、前記フェノール樹脂として、下記の一般式③で表されるフェノール樹脂を含有することを特徴とする★

★。

【0009】

【化6】



(式中R<sub>1</sub>、R<sub>2</sub>は、H、フェノール性水酸基、ハロゲン原子又は炭素数1～5のアルキル基で、nは繰り返し単位を示す1～5の数である。)

【0010】本発明の請求項3に係る半導体装置、請求項1又は請求項2記載の封止用エポキシ樹脂組成物の硬化物により封止してなることを特徴とする。

【0011】以下、本発明を詳述する。本発明に用いるエポキシ樹脂は、1分子中に少なくとも2個のエポキシ基を有するエポキシ樹脂であり、このエポキシ樹脂として、前記の一般式①で表されるビスフェニル型エポキシ樹脂及び/又は前記の一般式②で表されるジシクロペンタジエン系エポキシ樹脂を含有することが必須である。すなわち、ビスフェニル型エポキシ樹脂は剛直なビスフェニル骨格を有するため、得られる封止品が低弾性率であって、高い熱時強度を持ち、密着性に優れたものになり、

\*中に2個以上のフェノール性水酸基を有するフェノール樹脂、無機充填剤、硬化促進剤及び顔料を添加してなる封止用エポキシ樹脂組成物において、前記エポキシ樹脂として、下記の一般式①で表されるビスフェニル型エポキシ樹脂及び/又は下記の一般式②で表されるジシクロペンタジエン系エポキシ樹脂を含有し、かつ、前記顔料として、塩素化銅タクロシアニングリーンを封止用エポキシ樹脂組成物全量に対して0.05～1重量%及びカーボンブラックを封止用エポキシ樹脂組成物全量に対して0.01～0.2重量%含有することを特徴とする。

【0006】

【化4】

※ 【化5】

★。

【0009】

【化6】

ジシクロペンタジエン系エポキシ樹脂を用いることにより、硬化物の吸湿性が小さくなる。つまり、前記エポキシ樹脂を用いることにより、吸湿率を下げ、リードフレームとの密着性を向上させることができ、耐湿性、耐半田クラック性に優れた硬化物が得られる封止用エポキシ樹脂組成物になる。

【0012】本発明に用いる硬化剤としては、1分子中にフェノール性水酸基を少なくとも2個有する硬化剤であれば、いずれの硬化剤でも用いることができ、例えば、フェノールノボラック樹脂、クレゾールノボラック樹脂及び多官能フェノール樹脂等がある。

【0013】本発明では、無機充填材として、溶融シリ

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カ、結晶シリカ、アルミナ及び窒化ケイ素等を用いることができ、硬化促進剤として、ジアザビスクロウンデセン、トリフェニルホスフィン、テトラフェニルホスホニウム、テトラフェニルボレート、イミダゾール及び3級アミン等を用いることができる。また、必要に応じてエポキシシラン等のカップリング剤、ブロム化エポキシ樹脂及び三酸化アンチモン等の難燃剤、シリコーン可焼剤、カルナバワックス並びにステアリン酸等の離型剤を用いることができる。

【0014】本発明に係る封止用エポキシ樹脂組成物では、顔料として、塩素化銅フタロシアニングリーンを封止用エポキシ樹脂組成物全量に対して0.05～1重量%含有することが必須である。すなわち、塩素化銅フタロシアニングリーンの含有量が封止用エポキシ樹脂組成物全量に対して0.05重量%未満の場合には、緑色が薄くなり過ぎて、緑色とは、認識できなくなってしまう。1重量%を超える場合には、耐湿性が低下する。塩素化銅フタロシアニングリーンとともに、カーボンブラックを封止用エポキシ樹脂組成物全量に対して0.01～0.2重量%含有する必要がある。すなわち、カーボンブラックの含有量が封止用エポキシ樹脂組成物全量に対して0.01重量%未満の場合には、ポストキュア後に変色が発生し、0.2重量%を超える場合には、緑色とは、認識できず、黒色になってしまう。

【0015】本発明に係る封止用エポキシ樹脂組成物は、硬化剤であるフェノール樹脂として、前記の一般式③で表されるフェノール樹脂を含有することが好ましい。すなわち、前記の一般式③で表されるフェノール樹脂を用いることにより、硬化物の吸湿性が小さくなり、密着力が向上し、耐湿性、耐半田クラック性に優れた封止用エポキシ樹脂組成物が得られる。

【0016】このようにして、エポキシ樹脂に、硬化剤、無機充填剤、硬化促進剤及び顔料を添加して、混合、混練、粉碎し、さらに必要に応じて造粒して封止用エポキシ樹脂組成物を得る。さらに、この封止用エポキシ樹脂組成物を使用して、トランスファーマー成形等で半導体素子を封止して半導体装置を得るものである。

【0017】以上のように、本発明によると、耐湿性、耐吸湿半田クラック性、密着性に優れ、ポストキュア後の変色を低減した緑色の封止用エポキシ樹脂組成物及びそれを用いた半導体装置が得られる。

【0018】

【作用】本発明の請求項1に係る封止用エポキシ樹脂組成物は、エポキシ樹脂として、前記の一般式①で表されるビフェニル型エポキシ樹脂及び/又は前記の一般式②で表されるジクロロペンタジエン系エポキシ樹脂を含有するので、ビフェニル型エポキシ樹脂が剛直なビフェニル骨格を有するため、ビフェニル型エポキシ樹脂を用いることにより、得られる封止品が低弾性率であって、高い熱時強度を持ち、密着性に優れたものになり、ジシ

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ロペンタジエン系エポキシ樹脂を用いることにより、硬化物の吸湿性が小さくなる。かつ、前記顔料として、塩素化銅フタロシアニングリーンを封止用エポキシ樹脂組成物全量に対して0.05～1重量%及びカーボンブラックを封止用エポキシ樹脂組成物全量に対して0.01～0.2重量%含有するので、ポストキュア後の変色を低減した緑色の封止用エポキシ樹脂組成物が得られる。

【0019】本発明の請求項2に係る封止用エポキシ樹脂組成物は、フェノール樹脂として、前記の一般式③で表されるフェノール樹脂を含有するので、硬化物の吸湿性が小さくなり、密着力が向上し、耐湿性、耐半田クラック性に優れる。

【0020】本発明の請求項3に係る半導体装置、請求項1又は請求項2記載の封止用エポキシ樹脂組成物の硬化物により封止してなるので、耐湿性に優れ、緑色であり、ポストキュア後の変色を低減できる。

【0021】

【実施例】以下、本発明を実施例によって具体的に説明する。

【0022】(実施例1～実施例3及び比較例1～比較例4)表1に示した配合で下記の原料を使用した。エポキシ樹脂として、エポキシ当量195のオルソクレゾールノボック型エポキシ樹脂〔住友化学工業社製；品番ESC N195 XL-3〕(表1でエポキシ樹脂Aと記した)、ビフェニル型エポキシ樹脂〔油化シェルエポキシ社製；品番YX4000H〕(表1でエポキシ樹脂Bと記した)又はジクロロペンタジエン系エポキシ樹脂〔大日本インキ化学工業社製；品番EXA7200H〕を用いた。硬化剤として、フェノールノボック樹脂〔荒川化学社製；商品名タマノール752〕(表1で硬化剤Dと記した)又は軟化点80℃の前記の一般式③で表されるフェノール樹脂(表1で硬化剤Eと記した)を用いた。充填剤として、γ-ジクロキシプロピルトリメトキシラン(カップリング剤)でカップリング処理した溶融シリカを用いた。硬化促進剤として2フェニルイミダゾール、難燃剤としてエポキシ当量400のブロム化エポキシ樹脂及び三酸化アンチモン、離型剤としてカルナバワックスを用いた。顔料としてカーボンブラック、塩素化銅フタロシアニングリーン〔ネネカ社製；商品名パイナモングリーン〕を用いた。

【0023】前記の各実施例及び比較例において、前記配合成分を表1で示した割合の割合で用いてミキサーで3分間均一に混合分散した後、ロール温度100～120℃のミキシングロールで加熱、溶融、混練した。この混練物を、冷却し、粉碎して各封止用エポキシ樹脂組成物を得た。

【0024】以上で得た各エポキシ樹脂組成物をトランスファーマー成形機を用いて金型温度175℃、成形圧力50 kg/cm<sup>2</sup>で半導体素子を封止成形して60QFP

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TEG (外形: 15mm×19mm×t2.4mm)を得た。また、同じ成形条件でφ50mm×t3mmの吸湿率測定用円板及びポストキュア後の変色測定用円板を得た。また、密着性測定用のφ11.3mm×t10mmのプリン型の成形品を得た。

【0025】吸湿率、接着強度、耐吸湿半田クラック、\*

	実施例1	実施例2	実施例3	比較例1	比較例2	比較例3	比較例4
配	エポキシ樹脂A	—	—	—	119	119	119
	エポキシ樹脂B	119	—	46	—	—	—
	エポキシ樹脂C	—	130	45	—	—	—
	硬化剤D	67	66	—	67	67	67
	硬化剤E	—	—	96	—	—	—
合	ブROM化エポキシ樹脂	14	14	14	14	14	14
	三酸化アンチモン	14.5	14.5	14.5	14.5	14.5	14.5
	硬化促進剤	2	2	2	2	2	2
用	導電剤	3	3	3	3	3	3
量	バイナミングリーン	5	5	5	0.5	10	5
部	カーボンブラック	0.5	0.5	0.5	—	2	—
外	カップリング剤	5	5	5	5	5	5
一	溶剤シリカ	770	770	770	770	770	770
	合計	1000	1000	1000	1000	1000	1000
評	吸湿率(重量%)	0.16	0.21	0.14	0.30	0.30	0.30
	耐吸湿半田クラック	10個中の不良数	0	3	0	10	10
密着性	200時間後の	10個中の不良数	0	7	0	10	10
導性	600時間後の	10個中の不良数	5	10	0	—	—
硬	密着性[kg/cm <sup>2</sup> ]	45	35	47	12	12	12
	ポストキュア後の変色	良好	良好	良好	不可	良好	良好

【0027】表1において記載した測定値は、次の方法によった。

(1) 吸湿率

JIS K 6911準じて作製した直径50mm、厚み3mmの円板を温度85℃、相対湿度85%の雰囲気中に置き、7.2時間後の重量変化を測定した。

(2) 耐吸湿半田クラック

60QFP TEGを温度85℃、相対湿度85%の雰囲気中に置き、7.2時間吸湿後、250℃の半田に10秒間浸漬し、実体顕微鏡でクラックの有無を観察し、60QFP 10個中でクラックが発生したパッケージの個数を求めた。

(3) 耐湿信頼性

60QFP TEGを温度85℃、相対湿度85%の雰囲気中に置き、7.2時間吸湿後、250℃の半田に10秒間浸漬し、PCT (プレジャッククーアテスト) 133℃、相対湿度100%の雰囲気中に置き、200時間及び500時間後のアルミ回路のオープン不良(回路断線)の有無を観察し、60QFP 10個中でオープン不良が発生したパッケージの個数を求めた。

(4) 密着性

プリン型のキャピティにニッケル板で蓋をし、得られた封止用エポキシ樹脂組成物を170℃に加熱した金型内にトランスファー注入して硬化させ、トランスファー成形で成形品を得て、ニッケル板と成形品との密着力をプッシュルゲージで測定した。

(5) ポストキュア後の変色

\*耐湿信頼性及びポストキュア後の変色を測定した結果、表1に示したように実施例1～実施例3は、比較例1～比較例4より優れていることが確認できた

【0026】

【表1】

175℃、6時間のポストキュア前と後との色差を色差計で測定し、色差ΔEが2以下の場合を良好、2を超える場合を不可とした。

【0028】

【発明の効果】本発明の請求項1に係る封止用エポキシ樹脂組成物によると、ビフェニル型エポキシ樹脂が剛直なビフェニル骨格を有するため、ビフェニル型エポキシ樹脂を用いることにより、得られる封止品が低弾性率であって、高い熱強度を持ち、密着性に優れたものになり、ジシクロペンタジエン系エポキシ樹脂を用いることにより、硬化物の吸湿性が小さくなる。かつ、前記顔料として、塩素化銅フタロシアニングリーンを封止用エポキシ樹脂組成物全量に対して0.05～1重量%及びカーボンブラックを封止用エポキシ樹脂組成物全量に対して0.01～0.2重量%含有するので、ポストキュア後の変色を低減した緑色の封止用エポキシ樹脂組成物が得られる。すなわち、耐湿性、耐吸湿半田クラック性、密着性に優れ、ポストキュア後の変色を低減した緑色の成形品が得られる。

【0029】本発明の請求項2に係る封止用エポキシ樹脂組成物によると、吸湿性が小さくなり、密着力が向上し、耐湿性、耐半田クラック性に優れた成形品が得られる。

【0030】本発明の請求項3に係る半導体装置によると、請求項1又は請求項2記載の封止用エポキシ樹脂組成物の硬化物により封止してなるので、耐湿性に優れ、緑色であり、ポストキュア後の変色を低減できる。

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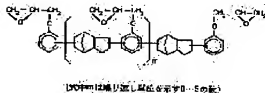
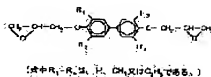
# PATENT ABSTRACTS OF JAPAN

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## (54) EPOXY RESIN COMPOSITION FOR SEALING AND SEMICONDUCTOR DEVICE USING IT



### (57)Abstract:

**PURPOSE:** To obtain an epoxy resin composition by which a moistureproof property and an absorbent solder crack-resistant property are enhanced by a method wherein a specific biphenyl-type epoxy resin and a dicyclopentadiene-based epoxy resin are contained as epoxy resins and chlorinated copper phthalocyanine green and carbon black in respectively specific amounts are contained as pigments.  
**CONSTITUTION:** A biphenyl-type epoxy resin expressed by Formula I and/or a dicyclopentadiene-based epoxy resin expressed by Formula II are contained as epoxy resins. Since the biphenyl-type epoxy resin comprises a rigid framework, a sealed product which is obtained has a low modulus of elasticity, its strength is high at a high temperature, and its close contact property is excellent. In addition, the absorbency of a hardened substance is small because the dicyclopentadiene-based epoxy resin is contained. In addition, 0.05 to 1wt.% of chlorinated copper phthalocyanine green with reference to the total amount of a resin component and 0.01 to 0.2wt.% of carbon black

with reference to the total amount are contained as pigments. As a result, it is possible to reduce a change of color after a posturing operation.

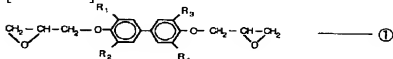
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 [Date of extinction of right]

## CLAIMS

### [Claim(s)]

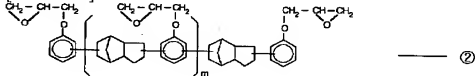
[Claim 1] The phenol resin which has two or more phenolic hydroxyl groups in 1 molecule as a curing agent in the epoxy resin which has two or more epoxy groups in 1 molecule, In the epoxy resin constituent for the closures which comes to add an inorganic bulking agent, a hardening accelerator, and a pigment The dicyclopentadiene system epoxy resin expressed with the biphenyl mold epoxy resin and/or following general formula \*\* which are expressed with following general formula \*\* as said epoxy resin is contained. As said pigment The epoxy resin constituent for the closures characterized by containing 0.05 - 1 % of the weight, and carbon black for chlorination copper Phthalocyanine Green 0.01 to 0.2% of the weight to the epoxy resin constituent whole quantity for the closures to the epoxy resin constituent whole quantity for the closures.

### [Formula 1]



(式中 R<sub>1</sub> - R<sub>4</sub> は、H、CH<sub>3</sub> 又は C<sub>2</sub>H<sub>5</sub> である。)

### [Formula 2]

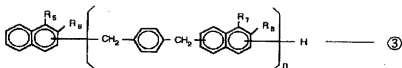


(式中 m は繰り返し単位を示す 0 ~ 5 の数)

[Claim 2] The epoxy resin constituent for the closures according to claim 1 characterized by containing the phenol resin expressed with following general formula \*\* as said phenol resin.

### [Formula 3]





式中 $R_5$ ~ $R_8$ は、H、フェノール性水酸基、ハロゲン原子又は炭素数1~5のアルキル基で、 $n$ は繰り返し単位を示す1~5の数である。

[Claim 3] The semiconductor device characterized by coming to close with the hardened material of the epoxy resin constituent for the closures according to claim 1 or 2.

## DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the epoxy resin constituent for the closures for closing an electrical part, electronic parts, a semiconductor device, etc., and the semiconductor device using it.

[0002]

[Description of the Prior Art] Although the hermetic-sealing method using the resin seal approach by the epoxy resin, silicon resin, etc., glass, a metal, the ceramics, etc. has been conventionally adopted as the closure approaches, such as electrical and electric equipment and electronic parts, such as diode, a transistor, and an integrated circuit, and a semiconductor device. In the closure method using the epoxy resin which has a merit in respect of mass production method or cost with improvement in dependability in recent years. Most generally the molding material which consists of a constituent which uses cresol novolak mold resin as a resinous principle, and uses phenol novolak mold resin as a curing agent component is used.

[0003] The thinning of mold resin is progressing and it is impossible however, to not necessarily correspond to satisfaction with an old epoxy resin constituent with the densification of electronic parts, such as IC, LSI, and VLSI, or a semiconductor device, and high integration. For example, in the device for surface mounts, since the device itself is rapidly put [ immerse / in solder / directly ] to the bottom of an elevated-temperature cruel environment at the time of mounting, it has been the situation under which generating of a package crack is not avoided. That is, a crack arises in the package of a semiconductor device, without the moisture which absorbed moisture during the storage after shaping carrying out evaporation expansion rapidly [ in case it is exposed to an elevated temperature ], and closure resin being able to finishing bearing this. Moreover, although there are some for which green is used in some of diodes and transistors, generally the epoxy resin constituent for the closures is black. There was a trouble that want to use it as an epoxy resin constituent for the closures since an image is good and conspicuous, but moisture resistance of green would be bad and would discolor it after a post cure if the usual green pigment is used.

[0004]

[Problem(s) to be Solved by the Invention] The place which this invention was made in view of the aforementioned situation, and is made into the purpose is excellent in moisture resistance, moisture absorption-proof solder crack nature, and adhesion, and is to offer the semiconductor device using the green epoxy resin constituent for the closures and green it which reduced the discoloration after a post cure.

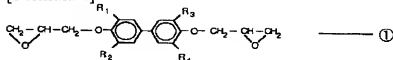
[0005]

[Means for Solving the Problem] The epoxy resin constituent for the closures concerning claim 1 of this invention. The phenol resin which has two or more phenolic hydroxyl groups in 1 molecule as a

curing agent in the epoxy resin which has two or more epoxy groups in 1 molecule, In the epoxy resin constituent for the closures which comes to add an inorganic bulking agent, a hardening accelerator, and a pigment The dicyclopentadiene system epoxy resin expressed with the biphenyl mold epoxy resin and/or following general formula \*\* which are expressed with following general formula \*\* as said epoxy resin is contained. As said pigment It is characterized by containing 0.05 ~ 1 % of the weight, and carbon black for chlorination copper Phthalocyanine Green 0.01 to 0.2% of the weight to the epoxy resin constituent whole quantity for the closures to the epoxy resin constituent whole quantity for the closures.

[0006]

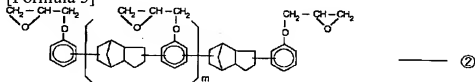
[Formula 4]



(式中 R<sub>1</sub>~R<sub>4</sub>は、H、CH<sub>3</sub>又はC<sub>2</sub>H<sub>5</sub>である。)

[0007]

[Formula 5]

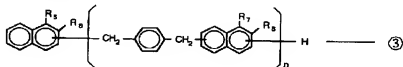


(式中mは繰り返し単位を示す0~5の数)

[0008] The epoxy resin constituent for the closures concerning claim 2 of this invention is characterized by containing the phenol resin expressed with following general formula \*\* as said phenol resin.

[0009]

[Formula 6]



(式中 R<sub>5</sub>~R<sub>8</sub>は、H、フェノール性水酸基、ハロゲン原子又は炭素数 1 ~ 5 のアルキル基で、nは繰り返し単位を示す 1 ~ 5 の数である。)

[0010] It is characterized by coming to close with the hardened material of the semiconductor device concerning claim 3 of this invention, and the epoxy resin constituent for the closures according to claim 1 or 2.

[0011] Hereafter, this invention is explained in full detail. The epoxy resin used for this invention is an epoxy resin which has at least two epoxy groups in 1 molecule, and it is indispensable to contain the dicyclopentadiene system epoxy resin expressed with the biphenyl mold epoxy resin and/or above general formula \*\* which are expressed with above general formula \*\* as this epoxy resin. That is, since a biphenyl mold epoxy resin has an upright biphenyl frame, the closure article obtained is a low modulus of elasticity, it has reinforcement at the time of high heat, and becomes the thing excellent in the adhesion force, and the hygroscopicity of a hardened material becomes small by using a dicyclopentadiene system epoxy resin. That is, by using said epoxy resin, moisture absorption can be lowered, the adhesion force with a leadframe can be raised, and it becomes the

epoxy resin constituent for the closures with which the hardened material excellent in moisture resistance and solder-proof crack nature is obtained.

[0012] If it is the curing agent which has at least two phenolic hydroxyl groups in 1 molecule as a curing agent used for this invention, any curing agent can be used, for example, there are phenol novolak resin, cresol novolak resin, polyfunctional phenol resin, etc.

[0013] In this invention, as an inorganic filler, fused silica, a crystal silica, an alumina, silicon nitride, etc. can be used, and diazabicycloundecene, triphenyl phosphine, tetra-phenyl phosphonium, tetraphenyl borate, an imidazole, tertiary amine, etc. can be used as a hardening accelerator.

Moreover, release agents, such as stearic acid, can be used for flame retarders, such as coupling agents, such as an epoxy silane, a bromine-ized epoxy resin, and an antimony trioxide, a silicone flexibilizer, and a carnauba wax list if needed.

[0014] It is indispensable to contain chlorination copper Phthalocyanine Green 0.05 to 1% of the weight to the epoxy resin constituent whole quantity for the closures as a pigment in the epoxy resin constituent for the closures concerning this invention. That is, when green becomes thin too much, it becomes impossible to recognize it as green to less than 0.05% of the weight of a case and the content of chlorination copper Phthalocyanine Green exceeds 1 % of the weight to the epoxy resin constituent whole quantity for the closures, moisture resistance falls. It is necessary to contain carbon black 0.01 to 0.2% of the weight to the epoxy resin constituent whole quantity for the closures with chlorination copper Phthalocyanine Green. That is, when discoloration occurs after a post cure in less than 0.01% of the weight of a case to the epoxy resin constituent whole quantity for the closures and the content of carbon black exceeds 0.2 % of the weight, it will become black, without the ability recognizing it as green.

[0015] As for the epoxy resin constituent for the closures concerning this invention, it is desirable to contain the phenol resin expressed with above general formula \*\* as phenol resin which is a curing agent. That is, by using the phenol resin expressed with above general formula \*\*, the hygroscopicity of a hardened material becomes small, the adhesion force improves, and the epoxy resin constituent for the closures which is excellent in moisture resistance and solder-proof crack nature is obtained.

[0016] Thus, it adds a curing agent, an inorganic bulking agent, a hardening accelerator, and a pigment and grinds [ mix, knead and ] to an epoxy resin, it comes if needed further, and the epoxy resin constituent for the closures is obtained. Furthermore, this epoxy resin constituent for the closures is used, a semiconductor device is closed by transfer molding etc., and a semiconductor device is obtained.

[0017] As mentioned above, according to this invention, it excels in moisture resistance, moisture absorption-proof solder crack nature, and adhesion, and the semiconductor device using the green epoxy resin constituent for the closures and green it which reduced the discoloration after a post cure is obtained.

[0018]

[Function] The epoxy resin constituent for the closures concerning claim 1 of this invention Since the dicyclopentadiene system epoxy resin expressed with the biphenyl mold epoxy resin and/or above general formula \*\* which are expressed with above general formula \*\* as an epoxy resin is contained Since it has a biphenyl frame with an upright biphenyl mold epoxy resin, by using a biphenyl mold epoxy resin The closure article obtained is a low modulus of elasticity, it has reinforcement at the time of high heat, and becomes the thing excellent in the adhesion force, and the hygroscopicity of a hardened material becomes small by using a dicyclopentadiene system epoxy resin. And since 0.05 - 1 % of the weight and carbon black are contained for chlorination copper Phthalocyanine Green 0.01 to 0.2% of the weight to the epoxy resin constituent whole quantity for the closures as said pigment to the epoxy resin constituent whole quantity for the closures, the green epoxy resin constituent for the closures which reduced the discoloration after a post cure is obtained.

[0019] Since the epoxy resin constituent for the closures concerning claim 2 of this invention contains the phenol resin expressed with above general formula \*\* as phenol resin, the

hygroscopicity of a hardened material becomes small, and its adhesion force improves, and it is excellent in moisture resistance and solder-proof crack nature.

[0020] Since it comes to close with the hardened material of the semiconductor device concerning claim 3 of this invention, and the epoxy resin constituent for the closures according to claim 1 or 2, it excels in moisture resistance, and it is green and the discoloration after a post cure can be reduced. [0021]

[Example] Hereafter, an example explains this invention concretely.

[0022] (An example 1 - an example 3, and the example 1 of a comparison - the example 4 of a comparison) The raw material following by the combination shown in Table 1 was used. as an epoxy resin -- the polyglycidyl ether of o-cresol-form aldehyde novolac of weight per epoxy equivalent 195 -- [ --; lot number ESCNby Sumitomo Chemical Co., Ltd. 195 XL-3] (it was described as epoxy resin A in Table 1), and a biphenyl mold epoxy resin -- [ --; lot number YXby oil-cycled shell epoxy company4000H] (it was described as epoxy resin B in Table 1), or a dicyclopentadiene --; lot number EXAby system epoxy resin [Dainippon Ink & Chemicals, Inc.7200H] was used. As a curing agent, the phenol resin (it was described as the curing agent E in Table 1) expressed with aforementioned general formula [ of phenol novolak resin [; trade name TAMANORU 752 by the Arakawa chemistry company] (it was described as the curing agent D in Table 1) or 80 degrees C of softening temperatures ] \*\* was used. As a bulking agent, the fused silica which carried out coupling processing by gamma-glycidoxypopyltrimetoxysilane (coupling agent) was used. 2-phenylimidazole was used as a hardening accelerator and carnauba wax was used as a flame retarder as the bromine-ized epoxy resin of weight per epoxy equivalent 400 and an antimony trioxide, and a release agent. Carbon black and chlorination copper Phthalocyanine Green [; trade name BAINAMON Green by Zeneka Co.] were used as a pigment.

[0023] a roll mill with a roll temperature [ after the combination shown in Table 1 coming out comparatively, using said combination component in each aforementioned example and the aforementioned example of a comparison and carrying out mixed distribution for 3 minutes by the mixer at homogeneity ] of 100-120 degrees C -- heating and melting -- it kneaded. This kneading object was cooled and ground and each epoxy resin constituent for the closures was obtained.

[0024] A transfer-molding machine is used for each epoxy resin constituent obtained above, and they are the die temperature of 175 degrees C, and the compacting pressure of 50kg/cm<sup>2</sup>. Closure shaping of the semiconductor device is carried out, and it is 60QFP. TEG (appearance: 15mmx19 mmx2.4mm) was obtained. Moreover, the disk for moisture absorption measurement of phi50 mmx3mm and the disk for discoloration measurement after a post cure were obtained by the same process condition. Moreover, the mold goods of the pudding mold of phi11.3 mmx10mm for adhesion measurement were obtained.

[0025] As a result of measuring the discoloration after moisture absorption, bond strength, a moisture absorption-proof solder crack, humidity-tolerant reliability, and a post cure, it is [0026] which has checked that the example 1 - the example 3 were superior to the example 1 of a comparison - the example 4 of a comparison as shown in Table 1.

[Table 1]

		実施例1	実施例2	実施例3	比較例1	比較例2	比較例3	比較例4
配	エポキシ樹脂A	—	—	—	119	119	119	119
	エポキシ樹脂B	119	—	45	—	—	—	—
	エポキシ樹脂C	—	130	45	—	—	—	—
	硬化剤D	87	56	—	87	87	87	87
	硬化剤E	—	—	96	—	—	—	—
合	ブロム化エポキシ樹脂	14	14	14	14	14	14	14
	三酸化アンチモン	14.5	14.5	14.5	14.5	14.5	14.5	14.5
	硬化促進剤	2	2	2	2	2	2	2
	離型剤	3	3	3	3	3	3	3
	バイナングリーン	5	5	5	0.5	10	5	—
集	カーボンブラック	0.5	0.5	0.5	—	2	—	5
	カップリング剤	5	5	5	5	5	5	5
	溶融シリカ	770	770	770	775	763.5	770.5	770.5
	合計	1000	1000	1000	1000	1000	1000	1000
	吸湿度 [重量%]	0.18	0.21	0.14	0.30	0.30	0.30	0.30
評	吸湿度半田クラック 10個中の不良数	0	3	0	10	10	10	10
	耐湿性 200時間後の 10個中の不良数	0	7	0	10	10	10	10
	500時間後の 10個中の不良数	5	10	0	—	—	—	—
	密着性[kg/cm <sup>2</sup> ]	45	35	47	12	12	12	12
	ポストキュア後の変色	良好	良好	良好	不可	良好	不可	良好

[0027] The measured value indicated in Table 1 was based on the following approach.

- (1) Moisture absorption JIS K It applied correspondingly 6911, the produced disk with a diameter [ of 50mm ] and a thickness of 3mm was left in the ambient atmosphere of the temperature of 85 degrees C, and 85% of relative humidity, and weight change 72 hours after was measured.
- (2) Moisture absorption-proof solder crack 60QFP It asked for the number of the package which left TEG in the ambient atmosphere of the temperature of 85 degrees C, and 85% of relative humidity, was immersed in 250-degree C solder for 10 seconds after 72-hour moisture absorption, and observed the existence of a crack with the stereoscopic microscope, and the crack generated in ten 60QFP.
- (3) Humidity-tolerant reliability 60QFP TEG was left in the ambient atmosphere of the temperature of 85 degrees C, and 85% of relative humidity, and it was immersed in 250-degree C solder for 10 seconds after 72-hour moisture absorption, and was left in PCT(pressure cooker test) 133degree C and the ambient atmosphere of 100% of relative humidity, the existence of poor opening (circuit open circuit) of the aluminum circuit of 200 hours and 500 hours after was observed, and it asked for the number of the package which poor opening generated in ten 60QFP.
- (4) The cavity of an adhesion pudding mold was covered with the nickel plate, in the metal mold heated at 170 degrees C, transfer impregnation is carried out, the obtained epoxy resin constituent for the closures was stiffened, mold goods were obtained by transfer molding, and the adhesion force of a nickel plate and mold goods was measured with the push pull gage.
- (5) 175 degrees C of discoloration after a post cure and the color difference of the post cure front of 6 hours and the back were measured with the color difference meter, and the case where fitness and 2 were exceeded for the case where color difference deltaE is two or less was made improper.

[0028]

[Effect of the Invention] Since it has a biphenyl frame with an upright biphenyl mold epoxy resin according to the epoxy resin constituent for the closures concerning claim 1 of this invention, by using a biphenyl mold epoxy resin, the closure article obtained is a low modulus of elasticity, it has reinforcement at the time of high heat, and becomes the thing excellent in the adhesion force, and the hygroscopicity of a hardened material becomes small by using a dicyclopentadiene system epoxy resin. And since 0.05 - 1 % of the weight and carbon black are contained for chlorination copper Phthalocyanine Green 0.01 to 0.2% of the weight to the epoxy resin constituent whole quantity for the closures as said pigment to the epoxy resin constituent whole quantity for the closures, the green epoxy resin constituent for the closures which reduced the discoloration after a post cure is obtained. That is, it excels in moisture resistance, moisture absorption-proof solder

crack nature, and adhesion, and the green mold goods which reduced the discoloration after a post cure are obtained.

[0029] According to the epoxy resin constituent for the closures concerning claim 2 of this invention, hygroscopicity becomes small, the adhesion force improves and mold goods excellent in moisture resistance and solder-proof crack nature are obtained.

[0030] Since it comes to close with the hardened material of the epoxy resin constituent for the closures according to claim 1 or 2 according to the semiconductor device concerning claim 3 of this invention, it excels in moisture resistance, and it is green and the discoloration after a post cure can be reduced.

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## TECHNICAL FIELD

[Industrial Application] This invention relates to the epoxy resin constituent for the closures for closing an electrical part, electronic parts, a semiconductor device, etc., and the semiconductor device using it.

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## PRIOR ART

[Description of the Prior Art] Although the hermetic-sealing method using the resin seal approach by the epoxy resin, silicon resin, etc., glass, a metal, the ceramics, etc. has been conventionally adopted as the closure approaches, such as electrical and electric equipment and electronic parts, such as diode, a transistor, and an integrated circuit, and a semiconductor device. In the closure method using the epoxy resin which has a merit in respect of mass production method or cost with improvement in dependability in recent years. Most generally the molding material which consists of a constituent which uses cresol novolak mold resin as a resinous principle, and uses phenol novolak mold resin as a curing agent component is used.

[0003] The thinning of mold resin is progressing and it is impossible however, to not necessarily correspond to satisfaction with an old epoxy resin constituent with the densification of electronic parts, such as IC, LSI, and VLSI, or a semiconductor device, and high integration. For example, in the device for surface mounts, since the device itself is rapidly put [ immerse / in solder / directly ] to the bottom of an elevated-temperature cruel environment at the time of mounting, it has been the situation under which generating of a package crack is not avoided. That is, a crack arises in the package of a semiconductor device, without the moisture which absorbed moisture during the storage after shaping carrying out evaporation expansion rapidly [ in case it is exposed to an elevated temperature ], and closure resin being able to finishing bearing this. Moreover, although there are some for which green is used in some of diodes and transistors, generally the epoxy resin constituent for the closures is black. There was a trouble that want to use it as an epoxy resin constituent for the closures since an image is good and conspicuous, but moisture resistance of green would be bad and would discolor it after a post cure if the usual green pigment is used.

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## EFFECT OF THE INVENTION

[Effect of the Invention] Since it has a biphenyl frame with an upright biphenyl mold epoxy resin according to the epoxy resin constituent for the closures concerning claim 1 of this invention, by using a biphenyl mold epoxy resin, the closure article obtained is a low modulus of elasticity, it has reinforcement at the time of high heat, and becomes the thing excellent in the adhesion force, and the hygroscopicity of a hardened material becomes small by using a dicyclopentadiene system epoxy resin. And since 0.05 - 1 % of the weight and carbon black are contained for chlorination copper Phthalocyanine Green 0.01 to 0.2% of the weight to the epoxy resin constituent whole

quantity for the closures as said pigment to the epoxy resin constituent whole quantity for the closures, the green epoxy resin constituent for the closures which reduced the discoloration after a post cure is obtained. That is, it excels in moisture resistance, moisture absorption-proof solder crack nature, and adhesion, and the green mold goods which reduced the discoloration after a post cure are obtained.

[0029] According to the epoxy resin constituent for the closures concerning claim 2 of this invention, hygroscopicity becomes small, the adhesion force improves and mold goods excellent in moisture resistance and solder-proof crack nature are obtained.

[0030] Since it comes to close with the hardened material of the epoxy resin constituent for the closures according to claim 1 or 2 according to the semiconductor device concerning claim 3 of this invention, it excels in moisture resistance, and it is green and the discoloration after a post cure can be reduced.

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## TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] The place which this invention was made in view of the aforementioned situation, and is made into the purpose is excellent in moisture resistance, moisture absorption-proof solder crack nature, and adhesion, and is to offer the semiconductor device using the green epoxy resin constituent for the closures and green it which reduced the discoloration after a post cure.

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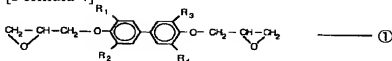
## MEANS

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[Means for Solving the Problem] The epoxy resin constituent for the closures concerning claim 1 of this invention The phenol resin which has two or more phenolic hydroxyl groups in 1 molecule as a curing agent in the epoxy resin which has two or more epoxy groups in 1 molecule, In the epoxy resin constituent for the closures which comes to add an inorganic bulking agent, a hardening accelerator, and a pigment The dicyclopentadiene system epoxy resin expressed with the biphenyl mold epoxy resin and/or following general formula \*\* which are expressed with following general formula \*\* as said epoxy resin is contained. As said pigment It is characterized by containing 0.05 - 1 % of the weight, and carbon black for chlorination copper Phthalocyanine Green 0.01 to 0.2% of the weight to the epoxy resin constituent whole quantity for the closures to the epoxy resin constituent whole quantity for the closures.

[0006]

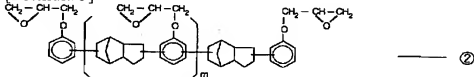
[Formula 4]



(式中 R<sub>1</sub> - R<sub>4</sub> は、H、CH<sub>3</sub>又はC<sub>2</sub>H<sub>5</sub>である。)

[0007]

[Formula 5]

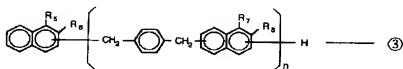


(式中mは繰り返し単位を示す0～5の数)

[0008] The epoxy resin constituent for the closures concerning claim 2 of this invention is characterized by containing the phenol resin expressed with following general formula \*\* as said phenol resin.

[0009]

[Formula 6]



式中R<sub>5</sub>、R<sub>6</sub>は、H、フェノール性水酸基、ハロゲン原子又は炭素数1～5のアルキル基で、nは繰り返し単位を示す1～5の数である。

[0010] It is characterized by coming to close with the hardened material of the semiconductor device concerning claim 3 of this invention, and the epoxy resin constituent for the closures according to claim 1 or 2.

[0011] Hereafter, this invention is explained in full detail. The epoxy resin used for this invention is an epoxy resin which has at least two epoxy groups in 1 molecule, and it is indispensable to contain the dicyclopentadiene system epoxy resin expressed with the biphenyl mold epoxy resin and/or above general formula \*\* which are expressed with above general formula \*\* as this epoxy resin. That is, since a biphenyl mold epoxy resin has an upright biphenyl frame, the closure article obtained is a low modulus of elasticity, it has reinforcement at the time of high heat, and becomes the thing excellent in the adhesion force, and the hygroscopicity of a hardened material becomes small by using a dicyclopentadiene system epoxy resin. That is, by using said epoxy resin, moisture absorption can be lowered, the adhesion force with a leadframe can be raised, and it becomes the epoxy resin constituent for the closures with which the hardened material excellent in moisture resistance and solder-proof crack nature is obtained.

[0012] If it is the curing agent which has at least two phenolic hydroxyl groups in 1 molecule as a curing agent used for this invention, any curing agent can be used, for example, there are phenol novolak resin, cresol novolak resin, polyfunctional phenol resin, etc.

[0013] In this invention, as an inorganic filler, fused silica, a crystal silica, an alumina, silicon nitride, etc. can be used, and diazabicycloundecene, triphenyl phosphine, tetra-phenyl phosphonium, tetraphenyl borate, an imidazole, tertiary amine, etc. can be used as a hardening accelerator. Moreover, release agents, such as stearic acid, can be used for flame retarders, such as coupling agents, such as an epoxy silane, a bromine-ized epoxy resin, and an antimony trioxide, a silicone flexibilizer, and a carnauba wax list if needed.

[0014] It is indispensable to contain chlorination copper Phthalocyanine Green 0.05 to 1% of the weight to the epoxy resin constituent whole quantity for the closures as a pigment in the epoxy resin constituent for the closures concerning this invention. That is, when green becomes thin too much, it becomes impossible to recognize it as green to less than 0.05% of the weight of a case and the content of chlorination copper Phthalocyanine Green exceeds 1 % of the weight to the epoxy resin constituent whole quantity for the closures, moisture resistance falls. It is necessary to contain carbon black 0.01 to 0.2% of the weight to the epoxy resin constituent whole quantity for the closures with chlorination copper Phthalocyanine Green. That is, when discoloration occurs after a post cure in less than 0.01% of the weight of a case to the epoxy resin constituent whole quantity for the closures and the content of carbon black exceeds 0.2 % of the weight, it will become black, without the ability recognizing it as green.

[0015] As for the epoxy resin constituent for the closures concerning this invention, it is desirable to contain the phenol resin expressed with above general formula \*\* as phenol resin which is a curing agent. That is, by using the phenol resin expressed with above general formula \*\*, the



hygroscopicity of a hardened material becomes small, the adhesion force improves, and the epoxy resin constituent for the closures which is excellent in moisture resistance and solder-proof crack nature is obtained.

[0016] Thus, it adds a curing agent, an inorganic bulking agent, a hardening accelerator, and a pigment and grinds [ mix, knead and ] to an epoxy resin, it comes if needed further, and the epoxy resin constituent for the closures is obtained. Furthermore, this epoxy resin constituent for the closures is used, a semiconductor device is closed by transfer molding etc., and a semiconductor device is obtained.

[0017] As mentioned above, according to this invention, it excels in moisture resistance, moisture absorption-proof solder crack nature, and adhesion, and the semiconductor device using the green epoxy resin constituent for the closures and green it which reduced the discoloration after a post cure is obtained.

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## OPERATION

[Function] The epoxy resin constituent for the closures concerning claim 1 of this invention Since the dicyclopentadiene system epoxy resin expressed with the biphenyl mold epoxy resin and/or above general formula \*\* which are expressed with above general formula \*\* as an epoxy resin is contained Since it has a biphenyl frame with an upright biphenyl mold epoxy resin, by using a biphenyl mold epoxy resin The closure article obtained is a low modulus of elasticity, it has reinforcement at the time of high heat, and becomes the thing excellent in the adhesion force, and the hygroscopicity of a hardened material becomes small by using a dicyclopentadiene system epoxy resin. And since 0.05 - 1 % of the weight and carbon black are contained for chlorination copper Phthalocyanine Green 0.01 to 0.2% of the weight to the epoxy resin constituent whole quantity for the closures as said pigment to the epoxy resin constituent whole quantity for the closures, the green epoxy resin constituent for the closures which reduced the discoloration after a post cure is obtained.

[0019] Since the epoxy resin constituent for the closures concerning claim 2 of this invention contains the phenol resin expressed with above general formula \*\* as phenol resin, the hygroscopicity of a hardened material becomes small, and its adhesion force improves, and it is excellent in moisture resistance and solder-proof crack nature.

[0020] Since it comes to close with the hardened material of the semiconductor device concerning claim 3 of this invention, and the epoxy resin constituent for the closures according to claim 1 or 2, it excels in moisture resistance, and it is green and the discoloration after a post cure can be reduced.

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## EXAMPLE

[Example] Hereafter, an example explains this invention concretely.

[0022] (An example 1 - an example 3, and the example 1 of a comparison - the example 4 of a comparison) The raw material following by the combination shown in Table 1 was used. As an epoxy resin -- the polyglycidyl ether of o-cresol-form aldehyde novolac of weight per epoxy equivalent 195 -- [ --; lot number ESCNby Sumitomo Chemical Co., Ltd. 195 XL-3] (it was described as epoxy resin A in Table 1), and a biphenyl mold epoxy resin -- [ --; lot number YXby oil-ized shell epoxy company4000H] (it was described as epoxy resin B in Table 1), or a dicyclopentadiene --; lot number EXAby system epoxy resin [Dainippon Ink & Chemicals, Inc.7200H] was used. As a curing agent, the phenol resin (it was described as the curing agent E in Table 1) expressed with aforementioned general formula [ of phenol novolac resin [; trade name TAMANORU 752 by the Arakawa chemistry company] (it was described as the curing agent D in Table 1) or 80 degrees C of softening temperatures ] \*\* was used. As a bulking agent, the fused silica which carried out coupling processing by gamma-glycidoxypolytrimetoxysilane (coupling

agent) was used. 2-phenylimidazole was used as a hardening accelerator and carnauba wax was used as a flame retarder as the bromine-ized epoxy resin of weight per epoxy equivalent 400 and an antimony trioxide, and a release agent. Carbon black and chlorination copper Phthalocyanine Green [; trade name BAINAMON Green by Zeneka Co.] were used as a pigment.

[0023] a roll mill with a roll temperature [ after the combination shown in Table 1 coming out comparatively, using said combination component in each aforementioned example and the aforementioned example of a comparison and carrying out mixed distribution for 3 minutes by the mixer at homogeneity ] of 100-120 degrees C -- heating and melting -- it kneaded. This kneading object was cooled and ground and each epoxy resin constituent for the closures was obtained.

[0024] A transfer-molding machine is used for each epoxy resin constituent obtained above, and they are the die temperature of 175 degrees C, and the compacting pressure of 50kg/cm<sup>2</sup>. Closure shaping of the semiconductor device is carried out, and it is 60QFP. TEG (appearance: 15mmx19mmx2.4mm) was obtained. Moreover, the disk for moisture absorption measurement of phi50mmx3mm and the disk for discoloration measurement after a post cure were obtained by the same process condition. Moreover, the mold goods of the pudding mold of phi11.3mmx10mm for adhesion measurement were obtained.

[0025] As a result of measuring the discoloration after moisture absorption, bond strength, a moisture absorption-proof solder crack, humidity-tolerant reliability, and a post cure, it is [0026] which has checked that the example 1 - the example 3 were superior to the example 1 of a comparison - the example 4 of a comparison as shown in Table 1.

[Table 1]

	実施例1	実施例2	実施例3	比較例1	比較例2	比較例3	比較例4
配	エポキシ樹脂A	—	—	119	119	119	119
	エポキシ樹脂B	119	—	45	—	—	—
	エポキシ樹脂C	—	130	45	—	—	—
	硬化剤D	67	56	—	67	67	67
	硬化剤E	—	—	96	—	—	—
合	プロム化エポキシ樹脂	14	14	14	14	14	14
	三酸化アンチモン	14.5	14.5	14.5	14.5	14.5	14.5
	硬化促進剤	2	2	2	2	2	2
	触媒剤	3	3	3	3	3	3
	バイナキングリーン	5	5	5	0.5	10	5
量	カーボンブラック	0.5	0.5	0.5	—	2	—
	カップリング剤	5	5	5	5	5	5
	南無シリカ	770	770	770	775	763.5	770.5
	合計	1000	1000	1000	1000	1000	1000
	吸湿率 [質量%]	0.18	0.21	0.14	0.30	0.30	0.30
評	吸湿率100%	0	3	0	10	10	10
	200時間後の	0	7	0	10	10	10
	10個中の不良数	5	10	0	—	—	—
	500時間後の	45	35	47	12	12	12
	10個中の不良数	良好	良好	良好	不可	良好	不可
係	密度 [kg/cm <sup>3</sup> ]	45	35	47	12	12	12
	ボストキエー後の変色	良好	良好	良好	不可	良好	不可

[0027] The measured value indicated in Table 1 was based on the following approach.

- (1) Moisture absorption JIS K It applied correspondingly 6911, the produced disk with a diameter [ of 50mm ] and a thickness of 3mm was left in the ambient atmosphere of the temperature of 85 degrees C, and 85% of relative humidity, and weight change 72 hours after was measured.
- (2) Moisture absorption-proof solder crack 60QFP It asked for the number of the package which left TEG in the ambient atmosphere of the temperature of 85 degrees C, and 85% of relative humidity, was immersed in 250-degree C solder for 10 seconds after 72-hour moisture absorption, and observed the existence of a crack with the stereoscopic microscope, and the crack generated in ten 60QFP.
- (3) Humidity-tolerant reliability 60QFP TEG was left in the ambient atmosphere of the temperature of 85 degrees C, and 85% of relative humidity, and it was immersed in 250-degree C solder for 10 seconds after 72-hour moisture absorption, and was left in PCT (pressure cooker test) 133degree C

and the ambient atmosphere of 100% of relative humidity, the existence of poor opening (circuit open circuit) of the aluminum circuit of 200 hours and 500 hours after was observed, and it asked for the number of the package which poor opening generated in ten 60QFP.

(4) The cavity of an adhesion pudding mold was covered with the nickel plate, in the metal mold heated at 170 degrees C, transfer impregnation is carried out, the obtained epoxy resin constituent for the closures was stiffened, mold goods were obtained by transfer molding, and the adhesion force of a nickel plate and mold goods was measured with the push pull gage.

(5) 175 degrees C of discoloration after a post cure and the color difference of the post cure front of 6 hours and the back were measured with the color difference meter, and the case where fitness and 2 were exceeded for the case where color difference  $\Delta E$  is two or less was made improper.